Name : .....
Roll No: .....

**MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM – 686 666**

**DEPARTMENT OF MECHANICAL ENGINEERING**
**FIRST SESSIONAL EXAMINATION AUGUST 2026**
**FIFTH SEMESTER – (ME)**

**B24ME3T02 THERMAL POWER ENGINEERING**

**Time – 1.5 Hour** **Max: 40 Marks**

**PART-A**
*Answer All Questions*

*Assumptions if any, must be clearly stated.*

*Use of Steam Tables and Mollier/T-s charts are permitted*

| | | | |
|---|---|---|---|
| 1. | Propose any six techniques that can be applied to enhance the overall performance and efficiency of a simple Rankine cycle. | **[CO 1]** | **3 Marks** |
| 2. | Draw a neat, well-labelled diagram of a Cochran boiler, showing all its essential mountings and accessories. | **[CO 1]** | **3 Marks** |
| 3. | A propulsion system needs to accelerate gas from subsonic to supersonic speeds. Identify the nozzle geometry required. Explain how this design works using compressible flow theory. | **[CO 2]** | **3 Marks** |
| 4. | Differentiate between an Impulse turbine and a Reaction turbine. | **[CO 2]** | **3 Marks** |

**PART-B**
*Answer All Questions*

| | | | |
|---|---|---|---|
| 5.a | Consider a reheat Rankine cycle operating between a boiler pressure of 5 MPa and a condenser pressure of 0.005 MPa. The maximum temperature of the cycle is restricted to 600°C due to metallurgical limits, and the optimal reheat pressure is set to one-fifth of the boiler pressure. Assuming an isentropic efficiency of 95% for the turbine expansion processes, draw the plant's component schematic and the corresponding T-s diagram, explicitly marking all key states. Furthermore, calculate the specific work for the high-pressure and low-pressure turbine stages, the net work output, the total heat supplied (boiler plus reheater), the cycle's thermal efficiency, and the specific steam consumption in kg/kW.h. | **[CO 1]** | **10 Marks** |
| 5.b | Consider a regenerative vapor power cycle with two feedwater heaters, a closed one and an open one, as shown in Figure 1. Steam enters the first turbine stage at 12 MPa, 480$^0$C. Identify the pressure levels and plot the vapour cycle in T-s diagram of water. You may assume the condenser and open type feed water heater discharges saturated liquid. Also the pressure drop in boiler, heaters and condenser can be neglected. | **[CO 1]** | **4 Marks** |

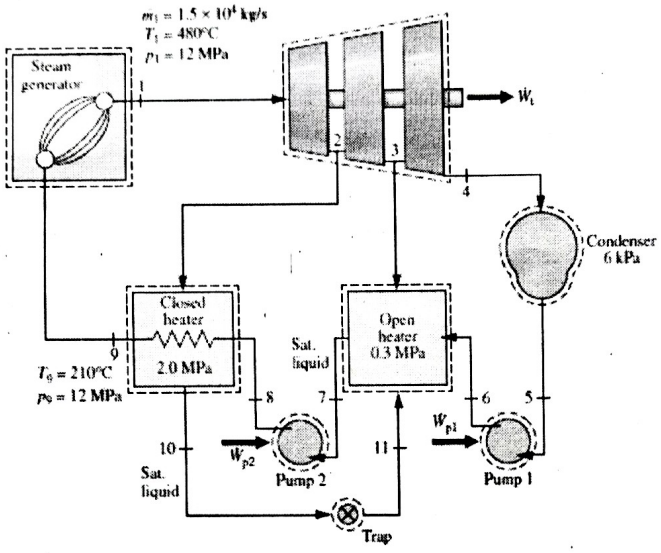



Figure 1

6. a Prove that the maximum mass flow rate through a nozzle is determined exclusively by the fluid's initial conditions and is independent of the back pressure. **[CO 2] 8 Marks**

6. b Dry saturated steam at a pressure of 10 bar enters a De-Laval nozzle and leaves at a pressure 2 bar. If the flow is adiabatic and frictionless, determine (i) steam velocity at throat and exit, and (ii) mass flux at throat section. Assume expansion index is 1.135. **[CO 2] 6 Marks**

## VISION

Mentoring to Ensure Excellence

## MISSION

- To facilitate comprehensive and integrated development of students by providing quality education that encourages sustainable practices
- To mold disciplined and socially committed engineers capable of assuming professional leadership upholding national integrity